Remarks

The Examiner's reconsideration of the application is urged in view of the amendments above, attachment hereto, and comments which follow.

This response is being filed as part of a Request for Continued Examination in view of claim amendment made above which obviously would not have been entered were the applicants to have filed an after final response.

I. Claim amendments

Claims 1, 2, 12 and 14 have been amended to overcome the rejections raised by the Examiner.

Claims 4 and 16 have been cancelled as their content has been introduced into claims 1 and 12, respectively.

Claims 3, 5 to 11, 13, 15 and 17 to 20 as currently on file have not been changed.

II. Amendment to the abstract

In accordance with the objection by the Examiner to the abstract, the abstract has been amended by changing "energisable" (line 4) into "energizable".

III. Claim objections

The wording "the first respectively second motor stator winding" and "the second respectively first motor stator winding" in originally filed claims 2 and 14 has been used to indicate that sensing the voltage on the first motor stator winding is carried out during energizing of the second motor stator winding and that sensing the voltage on the second motor stator winding is carried out during energizing of the first motor stator winding.

Claims 2 and 14 have been amended, accordingly, as already suggested in the response to the first Office Action.

Support for this amendment can be found in the originally filed application on page 12, lines 1 to 8.

IV. Claim rejections – 35 U.S.C. §102

Claims 1 to 20 of the application have been rejected by the Examiner under 35 U.S.C. §102 because the subject matter of claim 1 allegedly is anticipated by Fincher US 4,851,755. Applicants do not agree for the following reasons.

Independent claims 1 and 12 as currently on file have been amended by incorporating, respectively, originally filed claims 4 and 16, in order to clearly distinguish the present invention from Fincher.

The amendment to claim 1 and 12 is supported by the description on page 12, lines 28 to 30 of the present application where it is described that '... for transferring the value of the back EMF signal to a memory device at certain moments in time, for example the back EMF signal may be stored in a sample capacitor Cs'.

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Fincher relates to a motor drive system comprising a pulse detector/discriminator 32 (see Fig. 3) that indicates whether the motor 10 is in running condition.

When the detector 32 determines that the motor 10 is in a proper running condition, it applies an output signal of a first logic level via line 33 to an up-down current ramper 34. On the other hand, when circuit 32 determines that the induced pulse is incorrect, it assumes that the rotor has stalled, and applies via line 33 output signal of a second logic level to the up/down current ramper 34. In response to the signal on line 33 the ramper provides a decreasing or increasing ramp signal on line 36 to a power command adjustment circuit 38 (Col.5, l.45-55).

Detectors 52 compare the amplitude of each received pulse with predetermined amplitude limits for a positive and a negative pulse (Col.6, l.35-38).

The circuit 52 has four output lines. An output signal on line 61 indicates that a negative pulse across phase A has been detected, a signal on line 62 indicates a positive pulse

across phase A, a signal on line 63 indicates a negative pulse across phase B and a signal on line 64 indicates a positive pulse across phase B (Col.6, l.56-53 + Fig. 3). This clearly indicates that signals 61 to 64 are binary signals indicating the result of a comparison.

Circuit 54 compares the information obtained on lines 61 to 64 with the information on line 66 indicating which phase of the motor is presently being energized (Col.6, l.66-Col.7 l.3), and it provides an output pulse on line 65 of one logic level, for example a high level pulse, when comparison is obtained, and of a second logic level, for example a low level pulse when comparison is not obtained (Col.7, l.3-8). This indicates that the circuit 54 generates a 1 bit binary signal indicating whether there was a positive pulse or a negative pulse. No information is kept in the memory about the amplitude of the pulse.

History register 56 receives and stores a predetermined number of consecutive pulses applied thereto via line 65. The output signal on line 33 from the register 56 causes an up/down counter to count down. (Col.7, l.9-25). This shows that register 56 stores signal bit binary signals (1 or 0 per pulse) and generates a single bit binary output on line 33.

Because of the above, it is clear that in Fincher the result of a comparison made by a window comparator (true or false, 1 or 0) is stored while in the present invention voltage values of a sensed signal are stored. Hence, contrary to the statement of the Examiner, Fincher does not disclose storing voltage values in a memory device because a sensed voltage value (also information about amplitude!) is different from a single bit (1 or 0).

Therefore, amended claim 1 is not anticipated by Fincher.

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The method according to the present invention comprises sampling and storing the measured voltage, e.g. back EMF, as a complete value (or its digital representation through an analog-to-digital converter).

By storing the measured voltage values in a memory device, these voltage values can be used for further processing of the sensed voltage, e.g. back EMF, signal (see page 13, lines 7 to 22 of the originally filed application). Comparator levels are adjusted with historical averages of previously sampled values (Vint in Fig.4 or signal 35 in Fig.6 of the application as currently on file). This leads to auto-adaptive thresholds in a closed-loop directly.

The present invention thus discloses an analog circuit that stores the sample back EMF in a tracking storage memory (Ci in Fig.4) to create a history record of the samples taken. The comparators 16 verify then if the newly sampled back EMF is deviating much from the historical samples. Good samples are inside a window (i.e. small deviations from historical results). The comparator thresholds are adaptive and on the spot adjusted to the back EMF.

Fincher does not hint in the direction of storing full voltage values in a memory device and does also not disclose any further processing of the Vbemf signal.

Therefore, amended claim 1 is non-obvious in view of Fincher.

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For similar reasons as set out above for amended claim 1, amended claim 12 is novel and non-obvious in view of Fincher.

IV. Further cited references

1. US 4,520,302 relates to stepping motors and drive circuits therefor. According to embodiments of the invention, detection of rotor position is performed by using current rise. By doing so a considerable degree of immunity from motional EMF effects is obtained.

According to US 4,520,302 current flows are measured and not voltages as is the case with the present invention.

2. US 4,641,066 relates to a control apparatus for a brushless motor whose exciting phases are switched over in accordance with a signal of a counter electromotive force generated in the stator winding.

US 4,641,066 combines the polarity of the counter EMF generated during the rotational oscillation of a rotor of a brushless motor, in the armature coil of a phase, which is not excited while the armature coils of particular phases are excited at the time of starting of the brushless motor, with the pulse edges of the excitation switchover signal obtained from the neutral point potential of the armature winding and the neutral point potential of the detecting resistance circuit connected in star-connection and in parallel with the respective armature coils of the armature winding. Through this it is possible to detect a suitable starting point during the oscillation of the rotor and to achieve smooth starting control (Col.10, l.7-22).

Nothing is said, however, about storing measured voltages in a memory device.

3. US 5,254,914 relates to method and apparatus for use with a brushless DC motor which provide the capability of detecting the rotor position when the motor is stopped without the use of known rotor position detecting elements such as Hall elements (Col.1, l. 21-25).

The approach in US 5,254,914 is to measure the saturation level of the phase flux versus the current in a phase for each corresponding phase (Col.4, l.41-43). The saturation level is measured indirectly via monitoring the voltage induced in at least one un-energized winding (Col.4, l.52-54).

US 5,254,914 focuses on determining the starting position for a motor (Col.4, l.56-57). An accurate measure of the rotor position is achieved, but the use of the mutual inductance removes the detrimental effects of phase winding resistance variations (Col.9, l.34-37).

However, nothing is said about storing the measured values in a memory device.

4. US 5,990,656 relates to commutating date disk spindle motors using a phase lock loop controller (Col.1, l.5-6).

Back EMF voltage of an un-energized winding is used to determine the rotational position of a rotor (Col.7, l.1-4, l.8-11).

However, nothing is said on how or when the back EMF voltage is measured. Furthermore, nothing is said about storing the measured values in a memory device.

5. US 6,555,977 relates to a method and apparatus for detecting the position of an electric motor rotor by sensing the zero crossing or polarity change of a mutual inductance associated with the motor (abstract).

However, US 6,555,977 does not use a (back EMF) voltage to determine the position of the rotor, but uses inductance values (Col.10, l.52-65). Furthermore, US 6,555,977 does not mention anything about storing the measured values in a memory device.

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None of the above-described references hints in the direction of storing measured voltages in a memory device for comparing them with new measured voltages for use in further processing of the voltage signal.

Therefore, amended claims 1 and 12 are both novel and non-obvious in view of the cited prior art references.

By virtue of their dependency on amended claims 1 or 12 respectively, claims 2 to 11 and 13 to 20 are also novel and non-obvious in view of the cited prior art references.

It is therefore submitted that the application, as amended, is now in condition for allowance, and the Examiner's further and favorable reconsideration is urged.

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Respectfully submitted,

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